Lecture 4, January 18, 1954

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I. Previous discussion:

1. Located factor responsible for chromosome losses 1 to 2 crossover units to right of Wx.
2. The physical location of genetic markers in chromosome 9 short arm:

3. Distance between Wx and centromere -- more than 1/3rd the length of short arm.

4. Previous evidence and that of Longley and Anderson: crossing over between Wx and centromere more than 4% .

5. This suggests that factor responsible for losses is in short arm of chromosome 9, a short distance from Wx locus.

6. Evidence presented indicating that a second factor necessary for losses to occur. This inherited independently of factor in short arm of chromosome 9. Given symbol of Ac.
   a). Ac must be in nucleus for losses to occur.
   b). If Ac absent, no losses, no obvious evidence of presence of factor producing losses.

II. How does factor in short arm of chromosome 9 bring about losses of chromatin in presence of Ac? What occurs at this position in the chromosome?

1. Piece lost is gross. Should be able to see it or see evidence of its loss if sporopytes examined in plants carrying it.
2. This could be done if losses occur in the sporocytes themselves.
3. Evidence for such losses obtained from examination of pollen of plants carrying factor in Wx chromosome:

Begin page 8, section IV of previous talk - outline

Begin. Wed. Jan 2 The inheritance behavior and the mode of action of Ac

I. Presence of separate factor, needed for breaks to occur at Ds, suspected from early inheritance studies of Ds.

II. Many studies of inheritance behavior of Ac conducted. Select examples to serve as illustration of methods used.

1. Wish to start this with plant having constitution $\frac{\text{N C Sh wx Ds}}{\text{Re c sh Wx ds}}$ $\frac{\text{Ac}}{\text{ac}}$

   a). Sequence of crosses: On Board.

   b). Gametes produced by $\frac{\text{N C Sh wx Ds}}{\text{Re c sh Wx ds}}$ $\frac{\text{Ac}}{\text{ac}}$ plants:

(1)	N C Sh wx Ds	Ac	(3)	Re c sh Wx	Ac
(2)	"	ac	(4)	"	ac

2. These plants self-pollinated. Kernels on ear:

   C Sh Wx, non-variegated

   C Sh Wx with areas of c wx

   C Sh wx -- (normal and with homozygous deficient tissue)

   c sh Wx

3. The consitutions of the c sh Wx kernels -- or plants derived from them:

   F₂ ratio | Should be: 1 Ac Ac : 2 Ac ac : 1 ac ac. | To be tested for Ac

4. Must have method for testing for presence of Ac. Development of Ac-tester stocks.

III. Development of Ac tester stocks.

1. The $\frac{\text{N C sh wx Ds}}{\text{Re c sh Wx ds}}$ $\frac{\text{Ac}}{\text{ac}}$ plants used as male parents to $\frac{\text{Re c sh Wx}}{\text{Re c sh Wx}}$ $\frac{\text{ac}}{\text{ac}}$

2. Male gametes:

   To be tested for Ac.

   $\frac{\text{N C Sh wx Ds Ac}}{\text{Re c sh Wx ds ac}}$ $\boxed{\frac{\text{N C Sh wx Ds ac}}{\text{Re c sh Wx ds ac}}}$ $\frac{\text{Re c sh Wx Ac}}{\text{Re c sh Wx ac}}$ $\frac{\text{Re c sh Wx ac}}{\text{Re c sh Wx ac}}$

   Back-cross ratio

   Kernel phenotypes:

   C Sh Wx, areas of c sh — C Sh Wx non-var. — c sh Wx — c sh Wx

3. The C Sh Wx, non-variegated kernels: $\frac{\text{N C Sh wx Ds}}{\text{Re c sh Wx ds}}$ $\frac{\text{ac}}{\text{ac}}$

4. Plants grown from them. These self-pollinated:

   C Sh Wx, non-variegated: $\frac{\text{N C Sh Wx Ds}}{\text{Re c sh Wx ds}}$ $\frac{\text{ac}}{\text{ac}}$

   C Sh wx: $\boxed{\frac{\text{N C Sh wx Ds ac}}{\text{N C Sh wx Ds ac}}}$

   c sh Wx: $\frac{\text{Re c sh Wx}}{\text{Re c sh Wx}}$ $\frac{\text{ac}}{\text{ac}}$

5. The $\frac{\text{N C Sh wx Ds}}{\text{N C Sh wx Ds}}$ $\frac{\text{ac}}{\text{ac}}$ An Ac-tester stock. How used:

6. Assume Ac/ac constitution of plant with c / c constitution:

   Gametes: c, Ac ; 1 c, ac x C Ds, ac gametes:

   F ear: 1 C kernel with c areas : 1 C kernel, non-variegated;

Assume Ac/Ac constitution in c/c plant. Gametes: all c, Ac.

Plant crossed by C Ds, ac tester plant: All kernels on ear should be C with c areas.

Assume ac/ac; c/c constitution: all gametes c, ac. Crossed by Ac-tester stock: all kernels:

C Ds / c ds. ac ac. All Colored, non-variegated.

case I b.c.

IV. The tests for Ac in plants derived from c sh Wx kernels in backcross ears:

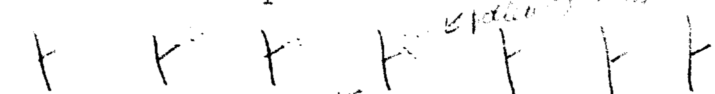
1. Expected ratios of Ac: 1 Ac/ac : 1 ac ac (See diagram of crosses).

2. The test cross:

a). Kernels selected; plants grown from them; crossed by $\frac{\text{C Sh wx Ds}}{\text{C Sh wx Ds}}\ \frac{\text{ac}}{\text{ac}}$

(1) Results: 180 plants tested:

Rows of plants



(2). The ears: 90 plants with 1 to 1 ratio of C Sh Wx non-var. to C Sh Wx, areas of c sh.

90 plants with all C Sh Wx, non-variegated kernels.

Lantern slide (1) Photo year

(3) Counts of Variegated to non-variegated kernels on ears:

Table 4a in Ac account.

Next: Ac-Tester to normal c class; k c sh Wx stocks = any kernels C sh non-var.

V. Tests for Ac constitutions in plants derived from self-pollination of (F2)

$\frac{\text{N C Sh wx Ds}}{\text{Re c sh Wx ds}}\ \frac{\text{Ac}}{\text{ac}}$ The c sh Wx kernels selected.

F2 Expected constitutions:

case II F2

$\boxed{1\ \frac{\text{Re c sh Wx ds}}{\text{Re c sh Wx ds}}\ \frac{\text{Ac}}{\text{Ac}}} : 2\ \frac{\text{Re c sh Wx ds}}{\text{Re c sh Wx ds}}\ \frac{\text{Ac}}{\text{ac}} : 1\ \frac{\text{Re c sh Wx ds}}{\text{Re c sh Wx ds}}\ \frac{\text{ac}}{\text{ac}}$

Crossed by C Sh wx Ds, ac tester plant: Ears expected:

All kernels C Sh Wx with c sh areas	½ kernels C Sh Wx nln-var. ½ C Sh Wx with c sh areas	All kernels C Sh Wx, non-variegated.

Observed: 61 plants: Ac Ac ears from 61 plants — 145 plants Ac ac ears from 145 plants — 68 plants ac ac ears from 68 plants

expect 67.2 — 136.4 — 68.2

Appearance of ears. (2 note non-var. kernels

VI. The non-variegated kernels on the Ac/Ac plant constitutions:

a). All kernels should be variegated if plants were Ac/Ac

b). Some kernels non-variegated as shown by photograph. Why?
Table 5 a, Ac account.

VII. Tests of Ac inheritance in c sh Wx/c sh Wx Ac Ac plants:

1. Besides cross by C Sh wx Ds, ac tester, some plants also ~~self pollinated~~ crossed by Re c sh Wx, ds , ac tester stocks.

2. Expect all gametes to be Re c sh Wx, Ac. If crossed by C Sh wx Ds ac tester stocks should get all plants with ears in which ratio of varl kernels to non-var. is 1 : 1:

Female gametes — Re c sh Wx ds, Ac

Male gametes: — N C Sh wx Ds, ac

~~All kernels on ears~~
All ears should show this ratio

Cws III f.c.q Ac/Ac results.

3. Observed ratios. Ears obtained from 96 plants.

On 95 of them: 1 C Sh Wx non-var. kernel to 1 C Sh Wx with c sh area

On 1 ear: All kernels non-variegated. No evidence of Ac

4. Question: What hashappened to Ac? Why is one plant ac/ac in constitution?

VIII. Return to ears produced by c sh Wx, ds, Ac/Ac plants. Photo:

1. What is Ac constitution in the kernels that show no variegation?

2. The tests of these kernels have shown what happens to Ac and why it is absent in some of the kernels and also in some of the plants derived from Ac/Ac plants. Will be discussed next period.

IX. Review of evidence of Ac inheritance:
1. Statistical ratios in backcross: 1 Ac to 1 ac found.
2. " " " F_2 : 1 AcAc : 2 Ac ac : 1 ac ac found.
3. All Ac/ Ac in self of Ac/Ac plant : Not found. 1 plant in 96 had no Ac
4. All kernels on ears of Ac/Ac plants should show brekas at Ds. This not found. A few kernels with no breaks -- no Ac?

X. Must consider patterns of loss produced by doses of Ac, before continuing

1. C Sh bz wx ♀ × I Bz_2 Ds Ac ♂. " Endosperm:

♀ C Sh wx C Sh wx ♂ I Bz_2 Ac

b. Ac dose = Ac ac ac
in endosperm ♂ ♀ ♀

c. The pattern of Ds breaks are - irregular. Photo ③ 1 Ac

2. C Sh Ds Ac ♀ × I Bz_2 Ds ac ♂.
endosperm
♀ C Sh Ac C Sh Ac ♂ I Bz_2 Ds

b. Ac dose = Ac Ac ac
♀ ♀ ♂

c. Pattern of Ds breaks - late. Photo ④ Ac Ac

3. C Sh Ds Ac ♀ × I Bz_2 Ds Ac ♂

a) Endosperm ♀ C Sh Ds Ac C Sh Ds Ac ♂ I Bz_2 Ds Ac

b) Ac dose = Ac Ac Ac Photo ④. Ac Ac Ac

4. Summary - Photo ⑤ summary of Photos ③+④
a) One dose of Ac = kernel sectored for early loss; late ones; no loss.
b) 2 doses = late loss
c) 3 doses: few losses and very late occurring. Endosperm may stop dividing before Ac action takes effect.

d). ? 4 doses, what would be seen ??

XI. The altered types of behavior of Ac - changes occurring:

1. Type I. ♀ C Bz Ac × ♂ I Bz Ds ac
   or
   C y Ac

   a) Background = heavily spk.
   Some changes occurring relatively late - sectors + areas of no loss Photo (6)

2. Type II. ♀ C Bz Ac × ♂ I Bz Ds ac
   changes occur in late 2nd division in microspores. in 95% of kernels:
   Photos (7), (8).
   Sectors occur: Ds breaks; mid. timed breaks; heavily spk; few fine — "1 Ac" — Ac Ac — "Ac Ac Ac" — Many: no Ac; Ac Ac Ac.

3. The changes occur at regulated times in development.
   The result appears as if Ac were being segregated during somatic divisions.
   These often occur in conjunction with a break at Ds.

XII. Return to Ac inheritance -

1. Ac Ac ♀ × ac ac ♂ = F1. Some plants do not have Ac
2. Means of Ac Ac ♀ × ac ac ♂ (C Ds). Some kernels do not show presence of Ac
   " " show altered type of action of Ac.
3. Means of Ac/ac ♀ × ac ac ♂ or reciprocal = fewer kernels with Ac
   Means of Ac ac plants -
   Further examples: (1) C ds/C ds, ac ac ♀ × I B/I Ds Ac/ac ♂
   15 ears: 1867 I, non-var kernels: 1639 I-C var kernels

(2) c ds/c ds, ac/ac ♀ × C Ds/C Ds Ac/ac ♂

10 ears: 1582 C, non var. kernels ; 1429 C→c var.

(3) $\frac{\text{Cy ds}}{\text{Cy ds}}$ ac/ac ♀ × I Ds/C Ds Ac/Ac ♂

4 ears I class : 16 I, non-var : 870 I-Cy var.

C " : 23 CBz " " : 895 CBz-Cy var.

Examination of plants derived from aberrant kernels on ears in cross of $\frac{\text{Re c sh Wx}}{\text{Re c sh Wx}}$ Ac/Ac ♀ × C Sh wx Ds ac ♂.

I. The appearance of ears – Project ear.

1. Majority show 1 kind of pattern
2. Few that show either
   a) no variegation
   b) Tiny specks of c
   c) Areas with few c specks
   d). Early changes – like 1 Ac.

II. The tests:

1. Kernels of all classes removed from ear. Plants grown from them. Each plant tested in various ways.
2. The constitution of the plants derived from the completely C, non-var. kernels

Supposed to be $\frac{\text{I C Sh wx Ds}}{\text{Re c sh Wx ds.}}$ What about Ac?

3. Type of test conducted with each plant:

① Self-pollinated: To test for transmission of 2 class 9.

② Crossed by ♂♂ I Ds / C Ds, ac ac: To again test for Ac in ♀ C class (by I Ds) and in ♀ c class (C Ds) and for the dosage.

③ Crossed to ♀♀ c ds / c ds, ac/ac. To test for Ac

④ " " " c ds / c ds, Ac/Ac. To test for action of Ds in c Sh Ds chromosome.

4. The results - summary in advance of presentation of evidence:

1. Some plants = no Ac present at all.

2. " " = Two Ac factors present; not linked to one another.

a) The endosperm constitution when 2 Ac present in ♀ parent

♀ Ac ; Ac ♀ Ac + Ac ac

Endosperm Ac Ac Ac Ac ac =

Rec C Wx Rec C Wx C Sh Ds ac

♀ ♀ ♂.

Appearance of kernels =

3. Some plants = 2 Ac factors. linked

4. " " = 1 Ac ". Behaves in inheritance as a unit but gives double-dose action

5 " " = 1 Ac behaves as if dosage action intermediate between 1 + 2 Ac.

On Board

Jan. 21 lecture

♀ = ♂

1). $\frac{c\ sh\ wx\ Ds}{c\ sh\ wx\ Ds}$ $\frac{ac}{ac}$ × $\frac{I\ Sh\ Wx\ Ds}{C\ Sh\ wx\ ds}$ $\frac{Ac}{ac}$; Crossing over between wx and Ds gives gametes with C Sh wx Ds

2) F_1 ear. Selected few kernels that were C Sh wx with col. areas derived from gametes.
Plants grown from them. Their constitutions: $\frac{C\ Sh\ wx\ Ds}{c\ sh\ wx\ ds}$ $\frac{Ac}{ac}$

3). used as ♂ parents in crosses to ♀♀ $\frac{Ic\ c\ sh\ wx\ ds}{Ic\ c\ sh\ wx\ ds}$ $\frac{ac}{ac}$

∴ Many C sh wx kernels with col. areas.
Plants derived from their kernels: $\frac{I\ C\ Sh\ wx\ Ds}{Ic\ c\ sh\ wx ..}$ $\frac{Ac}{ac}$.

On Board

$$\frac{\text{M C Sh wx Bz}}{\text{Re c sh Wx ds}} \quad \frac{Ac}{ac}$$

Self-pollinated.

Appearance of kernels on ear.

expected Constitution of plants derived from kernels in col. class

C Sh Wx non-var

C Sh Wx with c sh areas

C Sh wx

c sh Wx

1 $\frac{\text{Re c sh Wx ds}}{\text{Re c sh Wx ds}}$ $\frac{Ac}{Ac}$

2 " $\frac{Ac}{ac}$

1 " $\frac{ac}{ac}$.

Back crossed to $\frac{\text{Re c sh Wx ds}}{\text{Re c sh Wx ds.}}$ $\frac{ac}{ac}$

Appearance of kernel on ear. Genotype of plants from these kernels.

c sh Wx

1 $\frac{\text{Re c sh Wx ds}}{\text{Re c sh Wx ds}}$ $\frac{Ac}{ac}$

1 " $\frac{ac}{ac}$

C Sh Wx with areas of c sh

$\frac{\text{M C Sh wx Bz}}{\text{Re c sh Wx}}$ $\frac{Ac}{ac}$

C Sh Wx; non-var.

$\boxed{\frac{\text{M C Sh wx Bz}}{\text{Re c sh Wx ds}}}$ $\frac{ac}{ac.}$

Self. pollinated

2 C Sh Wx non-var

1. C Sh wx non-var.

1 c sh Wx

$= \frac{\text{M C Sh wx Bz}}{\text{M C Sh wx Ds}}$ $\frac{ac}{ac.}$

[illegible]